in 19 hours from St. Louis to Jefferson County, New York, a distance of 1,150 miles.

It is evident that under the management of an aeronaut a balloon can be kept longer in the air than an unmanned balloon, but, nevertheless, a balloon of 8,700 cubic feet capacity, carrying only self-recording instruments, which was liberated from Berlin in 1894, after attaining a height of 10 miles, was carried 700 miles to the borders of Bosnia, at a speed of 62 miles an hour. Still more remarkable, in its way, was the flight of a pair of kites last summer from the Royal Aeronautical Institute near Berlin. Five kites, which had lifted self-recording meteorological instruments to a height of 2½ miles, broke the wire that confined them to the ground and the two upper kites dragged it across the country for nearly 100 miles before they were finally checked, the trailing wire, 2 miles in length, furnished sufficient resistance to keep the kites flying throughout the night.

TRANSATLANTIC WEATHER.

In order to respond more completely to the needs of the shipping interests of the North Atlantic, the Chief of the Weather Bureau has entered into an arrangement with the Meteorological Office at London, Mr. W. N. Shaw, Secretary, by virtue of which the Weather Bureau will receive daily meteorological reports from London, Valencia, Blacksod Point, Malin Head, Stornoway, Sumburgh Head, Paris, Cuxhaven (Hamburg), Lisbon, and Ponta Delgada (Azores). The European observations are taken at 7 or 8 a. m., Greenwich mean time; the observations at the Azores are taken at 9 a. m. It is expected that these records will all be received at Washington, D. C., not later than noon, Greenwich time, or 7 a. m., seventy-fifth meridian time or eastern standard, and will be published daily in connection with the morning map at Washington. This will give steamers about to sail for Europe the latest information as to the condition of affairs on the European coast.

CORRELATION OF WEATHER IN DISTANT LOCALITIES.

Reports from Sydney, New South Wales, give accounts of the most disastrous hurricane in the Island of New Britain within the past twenty-five years. The storm lasted from December 7 to 10 and came after an unusually trying season of drought. The rain and squalls began on the 2d or 3d and increased in force daily until the hurricane and tremendous sea of the afternoon of the 7th. The center of this island lies in latitude south 6°, latitude 150° east of Greenwich; it is therefore about 28° due north of Sydney, Australia. The typhoons or hurricanes of this region are usually moving westward when they pass these islands, and as they circulate in a direction opposite to those of the Northern Hemisphere, they give New Britain heavy east winds when they pass to the north of it, but west winds when they pass to the south of it. The prevailing wind in the winter is north and west, being, in fact, a portion of the northeast trade wind of the northern trade region carried across the equator on its way toward and around Australia. But these winds are feeble and interspersed with many calms. Hurricanes are not nearly so frequent in this region of calms as they are further southeast, in the neighborhood of Caledonia, New Hebrides, Fiji, and Samoa, or to the northwest, in the neighborhood of the Carolines and Phillipines. It would not be surprising if the hurricane here reported were a very slow-moving one, just beginning and growing in the region of calms, before starting off on its travels.

The daily press has been full of accounts of the typhoons in the North Pacific Ocean, beginning with the destructive storms of November 13, at Guam, in which the U. S. S. *Yosemite* was lost, and continuing down to the end of December, with a series of gales and hurricanes on the route between Japan and British Columbia.

The hurricane at Hongkong on November 10 is mentioned on page 558 of this number of the MONTHLY WEATHER REVIEW.

The southern portions of the North Atlantic and North Pacific oceans seem to have been unusually free from cyclonic disturbances. On the other hand, as the passage of storms eastward is accompanied by southerly winds for a considerable distance south and east of the advancing front, therefore, we are not surprised to learn that the Sandwich Islands have been experiencing unusual southwest winds and rain. The special correspondent of the San Francisco, Cal., Chronicle, under date of November 20, at Honolulu, says:

> The severest "kona" that has been experienced for years swept these islands last week. The "kona" is the native name for a storm from the southwest, a direction from which few storms come in this region. In reality, it is a cyclonic disturbance crossing the Pacific, and when its track lies far enough south, it appears here as a southwest wind.
>
> The "kona" of last week was one of the severest that has ever been known. Although there were no actual losses of vessels, the shipping suffered severely. * * * The wind was accompanied by terrific rains. The Oahu Railroad suffered two washouts and a landslide, which disarranged traffic for three days. This is something that never occurred before. * * * On Kanau the flood came in such torrents as to break down a protecting cement wall. * * * On Molokai the torrent came down in such floods that at one time it scooped out a course for itself many feet deep, carrying millions of cubic feet of earth, rock, and boulders in its onrush. On Maui the rain fell at the rate of 4 inches a day for 3 days in succession. The telephone system of the island is in chaos. * * * The whole island of Haleakala seemed a rushing torrent and streams flowed in great volume where there were never known to be any before. Kahului was under water for several days. * * * During the storm on Maui the Iao River overflowed its banks, carrying a raging torrent to the sea.

The correspondent of the Washington Evening Star, Sereno E. Bishop, under date of November 21, 1900, writes as follows from Honolulu:

> The exceptionally hot weather here has been succeeded by unusually heavy rains during the past six weeks. The rain was deluging on the island of Maui; being accompanied by a violent gale, there was some destruction of property. It was more of a storm than has occurred in these parts for many years. You know that our group is absolutely exempt from anything like a hurricane or typhoon, just as we are wholly exempt from the extreme heats of the tropics or of Washington.
>
> It is a pleasure to note the practical success of the wireless telegraph between our islands * * * there seems to be no doubt that by February next we shall enjoy perfect telegraphic communication from Honolulu to Hilo across three sea channels.

Although a terrible storm passed over northern England and southern Scotland, yet here, as in the Pacific Ocean, when storm centers pass by far to the north, southern England experiences the mildest winter weather. Thus, on December 26, a despatch from London says:

> England has one of the greenest Christmases on record, for the weather has been so mild that primroses and corn flowers are abloom as far north as Liverpool and Yorkshire, while Devonshire revels in a subtropical climate and the Isle of Wight is a garden of roses in midwinter. Never have flowers been more abundant in the London market at Christmas time, nor has mistletoe been cheaper. * * * The London sky has been heavily clouded and the air filled with mist, while the weather has been unseasonably warm.

Reports from Nome, Alaska, say that the worst storm of the season as to high wind and heavy surf began October 31 and lasted until after November 3, when the steamer *Oregon* sailed. After the wind had blown from the southeast for sixteen hours, during which time all the vessels in port put to sea, it suddenly veered to the west and the thermometer dropped nearly 30°; the rain changed to snow and hail.

Advices from Dawson and the Yukon Valley state that at

Dawson on the average of the week, January 9–16, the mean temperature was —58°; the minima, —68° at Dawson and —78° at Forty Mile Creek, occurred on the 16th. These are the lowest temperatures on record in that region. From Skagway to Dawson and below, the Yukon is covered with deep snow. From Skagway to White Horse for 100 miles the railroad is blocked and all trains tied up.

On Tuesday, January 22, occurred a great hurricane in northern Norway.

On January 20 Santiago de Cuba reports the severest cold known for many years, viz, a temperature of 60° and dry northerly winds, that bring great discomfort.

On January 6 severe cold weather somewhat suddenly spread over Europe. A blizzard prevailed throughout southern Russia and southern Austria; a bitter easterly wind and gale prevailed on the east coast of Great Britain, frozen harbors and enormous snow drifts impeded traffic on the northern shore of the Black Sea, and violent gales in the Adriatic. Snow fell as far south as Naples, Rome, and Marseilles. The temperature at St. Petersburg and Moscow was unusually low even for those locations.

At Washington up to January 17 and in the Middle Atlantic States generally, the weather has also been remarkably warm, sunny, and entirely free from snow and with very little rain. The paths of our storm centers have passed to the west and north of us, but even those that came quite near gave us remarkably little precipitation, if, indeed, any at all.

If the atmosphere were a so-called perfect gas, namely, without internal friction, and if there were no irregularities on the earth's surface to introduce resistances, we might imagine that all local weathers, such as the diversities enumerated in the above items, are illustrations of the general principle that phenomena could occur in one portion of the globe entirely independent of those in neighboring portions. But this principle of discontinuous motions or surfaces of discontinuity can scarcely apply, except on the smallest possible scale and for very short intervals of time. We can have no doubt but that the larger phenomena of storms and droughts, winds, and calms, have at least a slight relationship with each other no matter where they occur on the globe.

The fact that the distribution of storm paths is the controlling factor, or the index to the general characteristics of the climate of any place, was perhaps first stated by the Editor in a letter suggesting his maps of storm frequency for the years March, 1871, to February, 1873, (published in 1874, in the Statistical Atlas of the United States, by General Walker), and has been more widely recognized since the publication of analogous charts for Europe by Dr. Köppen. It was early recognized that the storm paths vary from week to week, sometimes quite suddenly, and perhaps always inexplicably, as though they depended upon forces or other considerations quite beyond the limits of the daily weather map. Even the study of the daily international charts of the whole Northern Hemisphere has, as yet, simply increased our store of facts without giving us a satisfactory insight into the mechanism of the process. When the Editor compiled his Preparatory Studies in 1889 his idea was that the temperature and moisture of the lower layers of inflowing, ascending air must determine the formation of cloud and rain, the evolution of latent heat, the interception of the sunshine from above and the radiation from below; that, consequently, the local buoyancy of the atmosphere must, therefore, be recognized as the disturbing cause producing storms where we should otherwise have clear and quiet air. Back of this was the great question, why should there be any local air of special warmth or moisture? Why any differences of condition sufficient to start an initial inflow and uprising? From his study of local thunderstorms, Espy had concluded that local heating of special regions by the sunshine might start a sufficient initial ascending current; but the daily weather map had shown that generally speaking this local heating could not explain the origin of the great storm regions of from 100 to 1,000 miles in diameter. It is true that the West Indian hurricanes and the typhoons of the Indian Ocean had occasionally been traced back to very small beginnings, such as might plausibly be considered as due to local heating in the sunshine, but this would not at all apply to the storms whose centers circulate almost around the globe from China eastward over British Columbia, the Great Lakes, and St. Lawrence Valley, the North Atlantic Ocean, Norway, and Northern Russia. It was seen at once that in this region we have especially to do with cold air flowing southward from the Arctic region, and that the differences of buoyancy in the atmosphere are in this case due to air cooled by radiation rather than warmed by insolation, and the precipitation is formed "in consequence of the elevation of masses of warm air above the masses of cold air, which latter flow for example from the extreme northwest southward." (See Bull. Phil. Soc., Washington, D. C., April, 1874, Vol. 1, page 100.)

This cold air probably comes from the upper regions of the Arctic atmosphere, descending by virtue of its own gravity as it cools and pushes southward by centrifugal force along the earth's surface, so that it is not necessary to speak of these storms as originating in the upper atmosphere. In 1890 Hann in his study of the European area of high pressure of November 11–23, 1889, throws doubt upon the idea that an area of high pressure is in reality simply a mass of descending cold air, or that an area of low pressure is a mass of ascending warm air. Consequently there has been a growing conviction that the movements in the upper atmosphere, viz, above the altitude of the cirrus clouds, are in some way responsible for the origin and maintenance of the storms at the earth's surface. It is recognized that these movements in the upper air can best be considered as the result of the general difference of temperature between the equator and the pole, and that they, therefore, belong to what is called the general circulation of the atmosphere. This general circulation must consist of an upper region in which the air flows eastward and northward, and a lower region in which the air flows eastward and southward in the higher latitudes, but westward and southward within 30° or 40° of the equator. The investigation of the peculiarities of this general circulation is a matter that is especially demanding attention from all students of meteorology. From the observational point of view it is of the highest importance to increase the accuracy of our cloud work; to send up and maintain kites at the highest attainable altitude, and especially to send up sounding balloons which can bring back records from an elevation of 40,000 feet, and, perhaps, by perfected construction from 100,000 feet. Moreover, these explorations of the upper air must be conducted over as wide a range of latitude as is any way possible.

On the other hand, from a theoretical point of view, the mathematician must return to his study of the equations of motion and solve them by the introduction of assumptions that represent the actual condition of the atmosphere more closely than do those hitherto made. It seems almost certain that the general circulation as we have defined it can not be represented by any so-called steady motion, but is a

case in which certain steady currents are separated from each other by areas of quasi-discontinuous motion, viz, of steady currents separated by whirls, rolls, vortex rings, cyclonic or anticyclonic vortices, or other forms of discontinuous motion. If these possible discontinuities harmonize with the observed areas of steady wind and pressure, then we shall recognize the precise mechanism by which our storms originate in the general circulation. But it will still, probably, always be true that the development from a modest initial low to a destructive storm depends upon the condensation of the moisture carried by the lower atmosphere.

The method of study by the use of isostaths introduced in The Preparatory Studies and the accompanying tables, which were afterwards published in the Smithsonian Meteorological Tables of 1893, are much improved upon by the use of the isosteres and other details of the method of Bjerknes and Sandström and will, doubtless, be still further improved by the studies now being prosecuted by Professor Bigelow.

NEW METEOROLOGICAL STATIONS NEEDED.

Two parties will be dispatched at an early date by the United States Geological Survey to explore the region in Alaska north of the Yukon River. One of these parties will start from some point on the Koyukuk River, cross over to the shores of the Arctic Ocean, and return by a different route. The other party will proceed from some point on the upper Koyukuk westward to Kotzbue Sound.

In view of the fact that but little is known concerning the meteorological conditions of this region, it is undoubtedly desirable that the necessary instruments should be carried thither, and if possible one or more permanent stations be established. It seems likely that voluntary observers of temperature, rainfall, wind, and weather can be found even in this region. Unfortunately, the demands for apparatus at the regular stations and the steady increase in our home stations, forces the Weather Bureau to decline requests for new stations or explorations in distant regions, as its supply of instruments on hand is generally at a very low ebb and oftentimes quite exhausted. There is no branch of science that is expanding more rapidly than meteorology, and still further expansion in the future is inevitable. The general study of the atmosphere demands at least one good station for every circle of 200 miles in diameter, or say, 30,000 square miles, and the fact that we have perhaps twice as many within the United States simply shows how many local conditions must be provided for and that the Weather Bureau must provide for local peculiarities as well as the general study of the atmosphere.

The great westerly currents that prevail high above the North Pacific Ocean and Alaska have such an influence upon the weather that is brought to America that we shall never fully understand our daily weather map until we appreciate what is going on far to the westward and far above us. It would seem that the nations of the globe must by some international arrangement provide at joint expense for regular meteorological stations on the smaller islands of the Atlantic and Pacific and in the less frequented portions of the continents.

LIGHTNING FROM CLOUDLESS SKIES.

A letter from Mr. A. B. Elmer, Northfield, Mass., referring to page 292–3 of the MONTHLY WEATHER REVIEW for July, says:

The phenomena observed from Newburg, N. Y., as between southeast and east, was observed from here as between south-southwest and south-southeast, and seemed to approximate the same distance. I had supposed it to be a thunderstorm over Long Island or the ocean, rather than a "lightning aurora." The New England Weather Bulletin shows no rain at the voluntary stations in Connecticut that day, and I have not access to the New York State bulletin.

The rest of Mr. Elmer's communication is devoted to the remarkable meteorological phenomena of November 7, 8, and 9. The severe storms that passed over New England on Thursday, November 8, are worthy of a special study, such as can only be attained by the comparison of the reports from many stations. Over a large region warm rain, heavy hail, snow, thunderstorms, and over Narragansett Bay a fine waterspout are only some of the more conspicuous peculiarities. In conclusion, Mr. Elmer says:

Except for the September gale, and a number of frequent thunderstorms, this thunderstorm in November, with a temperature under 62°, which is the usual limit for lightning, is the first unusual meteorological phenomenon since the sudden temperature changes of May, and the high temperatures of October. On May 11, 1900, I observed a minimum temperature of 15.5° and on May 14 a maximum of 95,.5° being a rise of 80° in three days.

LAKE COMMERCE AND INSURANCE.

Prof. H. J. Cox communicates the special report on lake marine losses for the year 1900, compiled by Mr. H. J. Carr, of Chicago, the manager of the Lake Marine News. Mr. Carr says:

Marine underwriters have come out better during the season just closed than during many previous years. The long list of losses comprised mainly vessels that had attained an age which prevented insurance. * * * There were reported in the Marine Insurance Bulletin, during the season of 1900, 502 losses of all kinds, as compared with 569 losses in 1898 and 386 in 1899. * * * The most dangerous parts of the Great Lakes, as shown by the record of losses, lay between Lake Huron and Lake Erie. * * * Taking into comparison the character and age of the ships lost with the new tonnage under construction, the rapid change in the lake marine becomes marked. No more boats like those that have passed away are being built. Practically nothing but steel ships of large size are under construction.

In the navigation of the Great Lakes, the most marked feature during the October storms was the caution displayed by masters in keeping in harbors of refuge. One night 67 boats were sheltered at Harbor Beach, in Lake Huron, and for a week navigation was practically at a standstill, so careful were masters in keeping out of dangerous seas. It was doubtless due to this caution that October, with its cycle of storms, saw so few losses of vessels and lives. Much closer attention was paid to the warnings of the Weather Bureau than ever before. The rapid extension of that service and the construction of warning towers at all important points has added greatly to its efficiency. The next move will be the adoption of wireless telegraphy from many of the warning towers, by which warnings can be passed from the towers to passing vessels.

The above report is written from the point of view of the marine underwriter, but in the Chicago Chronicle of December 12 we find another view of the case, suggested by the fact that a large percentage of the commerce of the lakes is transacted without any marine insurance. The Chronicle says:

The tempests on the lakes have been violent and disastrous to vessel property. In some wrecks the crews and passengers were lost. In fact, the entire season of navigation on the lakes has been remarkable for the number of persons drowned in shipwrecks. The loss of life is greater by 20 per cent than during any recent previous year.

The temptations of vessel owners to defy the winds and waves after the season of navigation should close have been very great. Cargoes more than sufficient to fill all the available vessel room are constantly offered at high rates. This fact applies to both ocean and lake commerce.

On the lake the pressure to get grain cargoes to the seaboard and the pressure to get coal and merchandise from the East before railroad winter rates go soaring upward has caused the employment of every vessel by which shipments could be made. The insurance season expired some time ago. The weather office hourly hangs out danger warnings; but steam and sail craft continue to start out on their perilous voyages. Passengers court the dangers of winter inland and ocean navigation.